REMARKS

Claims 1-31, including independent Claims 1, 24, and 29-31 were pending in the subject application. After entry of the amendment set forth above, the same numbers of Claims 1-31 remain pending, including the same-numbered independent Claims 1, 24, and 29-31.

Amendment

No new matter is added by the present amendment.

Claims 1, 24, and 29-31 have been amended to correct an informality: "measuring a weight vector perturbation vector" in a receiver is engineering shorthand for "measuring a signal transmitted in accordance with a weight vector perturbation vector," as would be readily understood by one of skill in the art. The relevant amendment inserts --signal(s) transmitted in accordance with-- between "measuring" and "(multiple) weight vector perturbation vector(s)." The amendment is supported by the application as filed, as explained in the following remarks which refer to Figures 4, 5 and 7 (and see the corresponding text, *e.g.*, pg. 14, l. 15 to pg. 19, l. 13, and pg. 18, l. 17 to pg. 19, l. 13).

A transmitter (*e.g.*, 50 in Fig. 4) applies weights (*e.g.*, $w_{0,even/odd}$ and $w_{1,even/odd}$) determined in accordance with a weight vector perturbation vector (see, *e.g.*, blocks 102 and 104 of Fig. 7) for modifying signals (*e.g.*, at 56 and 58) to be transmitted from a plurality of antennae (*e.g.*, 52 and 54). The transmitted signal is received by a receiver antenna (*e.g.*, 82 of Fig. 5) to obtain channel estimates (*e.g.*, $\hat{c}_{even}$ and $\hat{c}_{odd}$). The feedback b is based on a comparison of the channel estimate powers, as indicated at 96. The "measurement," in the receiver embodiment illustrated in Fig. 5, includes determining a power of a channel estimate. Such a measurement is, of course, measurement of a signal resulting from application of the WVP vector, rather than measurement of a WVP vector *per se*, as the shorthand statement might lead one unskilled in the art to suppose. Indeed, the WVP vector itself is a computational quantity that exists only in the transmitter, and is not literally present at the receiver to be measured, which makes the informality obvious to one of skill in the art.

The following remarks are set forth for the record, in accordance with the responsibility, established by the *Festo* line of cases, to explain amendments. The amendments remarked upon above do not change the scope of the claim. Instead, the amendments correct informalities that would be obvious to one of skill in the art, by stating explicitly what one of skill in the art would understand the informal language to convey. The accuracy of remarks regarding scope is of no relevance to the allowability of the claims, for which purposes it is only necessary that amendments are properly supported (as has been amply demonstrated, in this case, by the foregoing remarks).

Claims 20, 22 and 23 have been amended to correct a mistaken use of the term "comprises." What was meant, obviously, was "consists of." This error is obvious because otherwise the claims would have little meaning, and Claim 20, in particular, would have essentially no meaning at all as a limitation (because feedback cannot properly comprise *less* than one bit).

Claims 25-28 have been amended to correct an obvious error in the preamble. These claims depend from Claim 24, which is an apparatus, but (due to a word processing error) were introduced as method claims. The other amendments in Claim 28 are non-substantive stylistic adjustments that do not affect claim scope.

The amendments to Claim 31 largely constitute rearrangements of previous elements. However, original clause (a) has been deleted, because it described a step performed by the transmitter, which therefore is inappropriate for a receiver. Deletion of clause (a) technically broadens Claim 31. Other changes constitute mere clarification of the previously claimed receiver limitations, and do not narrow the claim scope. (Remarks regarding scope, again, are primarily for the record, and are relevant to examination only insofar as they bear on the question of whether or not a further search and/or rejection is "necessitated by the Applicant's amendments.")

Rejections over Gerlach and Harrison

In section 2 of the current Office Action, the Examiner rejects each of the independent Claims 1, 24, and 29-31, as well as dependent Claims 2, 4, 11-14, 20-23, and 25-28, as anticipated by Gerlach ("Adaptive Transmitting Antenna Arrays with Feedback," Gerlach et al., IEEE Signal Processing Letters, Vol. 1, No. 10, October 1994). These grounds for rejection are respectfully traversed. As demonstrated in the remarks set forth below, Gerlach fails to teach, disclose, or fairly suggest numerous of the limitations recited in any of the independent claims, and thus fails to anticipate (or render obvious) any of the independent claims, or any of the claims properly depending therefrom.

Gerlach fails to teach, disclose or fairly suggest a weight vector perturbation ("WVP") vector. As such, Gerlach does not remotely suggest "overlaying" WVP vectors (required in element 'a' of Claim 1), "measuring signals transmitted in accordance with multiple" WVP vectors (required in element 'b' of Claim 1 as presently amended), or "determining a new" WVP vector (required in element 'd' of Claim 1).

Moreover, Gerlach fails to teach, disclose or fairly suggest "a measurement interval having a greater duration than a feedback interval" (required in element 'b' of Claim 1). Because Gerlach fails to disclose a multiplicity of limitations recited in Claim 1 (both as presently amended, as as originally filed), Gerlach entirely fails to anticipate the invention claimed therein.

In section 4 of the current Office Action, the Examiner rejects Claim 3 as obvious over Gerlach in view of Harrison (US Patent 6,434,366). However, Harrison also fails to disclose any of the elements of Claim 1 which are noted above to be absent from Gerlach. As such, Harrison cannot remedy the failures of Gerlach. Accordingly, even the combination of these cited references entirely fails to support a *prima facie* case of obviousness for Claim 1, which is therefore clearly nonobvious over the cited references. The remarks set forth below provide further support for this conclusion, and also provide context to understand the extensive distinctions between the teachings of the Applicant as compared to that of the cited references.

Weight Vector Perturbation Vectors

TxAA (Transmit Adaptive Antenna) systems generally have multiple antenna elements, and the amplitude of signals transmitted from each element is adjusted on the basis of a corresponding adaptive weighting value. The set of one such weighting value for each antenna is a weight vector (WV); thus, virtually all TxAA systems employ adaptive weight vectors (WVs).

The Applicant, in a parent to the present application, developed a related vector: a Perturbation Vector, which is used to modify WVs. Thus, more particularly, such a vector is a Weight Vector Perturbation ("WVP") vector. Though related, it is NOT a weighting vector, but is rather a vector for temporarily modifying (perturbing) a current weight vector.

The embodiment of Figure 10, for example, employs an "odd" weight vector $\mathbf{w}_{odd}$ and an "even" weight vector $\mathbf{w}_{even}$. $\mathbf{w}_{even}$ is equal to a current or "base" weight vector $\mathbf{w}_{base}$, modified (perturbed) by a perturbation vector **v** (scaled by a scaling value beta) and then normalized. $\mathbf{w}_{odd}$ is similarly "perturbed" from $\mathbf{w}_{base}$, except by the negative of the perturbation vector **v** (suitably scaled by beta, and normalized; see, for example, pg. 23 lines 16-31). The perturbation vector **v** has one element value for each antenna element, just as the weight vector does.

Details of an exemplary embodiment, such as are set forth above, are not to be construed as limiting Claim 1. However, these details may assist the Examiner to better understand that a WVP vector is, as its terms require, entirely different from a weight vector: it is a perturbation vector for use in *modifying* (perturbing) a weight vector.

Some benefits that may accrue from proper use of WVP vectors are now set forth. These remarks are not to be construed as limiting the scope of any claim, but rather provide a context that may be useful for understanding the claimed invention. Referring again to FIGURE 10, it will be seen that the actual antenna weight vector alternates between "even" values and "odd" values. The mobile station can integrate the signals received during a number of different "even" periods, and can integrate the signals received during a number of different "odd" periods. At the end of integration periods sufficiently long to reduce quantization and channel noise, the two resulting

integrated received signal values are compared at the receiver. The receiver (*e.g.*, mobile station) need only inform the transmitting station as to which provides better results, the "even" weights or the "odd" weights. Thus, only a single bit need be communicated from the receiver to the transmitter to provide completely serviceable feedback as to antenna weightings. This is vastly superior to the situation described in Gerlach, which requires $m * d * 4.2$ bits (*i.e.*, 4.2 bits for each combination of antenna element and signal, or receiver). Even in a simple case (just two transmit antennae), the Applicant's approach reduces the feedback bit rate by a factor of approximately 16; for multiple antennae, the Applicant's approach saves even more data. The Examiner's attention is directed to the last sentence of Gerlach, which plaintively notes that "[m]ethods of reducing the feedback rates are needed." The Applicant has succeeded dramatically in solving the problem left by Gerlach.

In view of the foregoing remarks, it should be abundantly clear that neither Gerlach nor Harrison teach, disclose or fairly suggest WVP vectors. However, the mere use of WVP vectors is not a primary point of the subject application. Use of WVP vectors was described and claimed in a parent application (USSN 09/632,081, possibly now a US Patent). The subject application is a continuation-in-part of the parent, and is directed to novel uses of WVP vectors. In particular, for example, Claim 1 requires "overlaying" WVP vectors, "measuring signals transmitted in accordance with multiple" WVP vectors, and "determining a new" WVP vector. Because neither Gerlach nor Harrison even describes WVP vectors, far less do they describe, teach or fairly suggest any of these particular features that employ WVP vectors.

Measurement Interval Exceeding Feedback Interval

In the ordinary course of TxAA feedback, both as described in Gerlach and as described in Harrison, a measurement interval is provided during which the receiver measures the signal actually received, and then compares the measured signal with the (known) signal that was actually transmitted to estimate the channel from each transmit antenna element to the receiver. In Gerlach the measurement interval corresponds to a "probe mode" (see, for example, the last paragraph of page 151 col. 1, and item 3 in the first column of page 152 of Gerlach), while in Harrison the measurement interval is a pilot signal period (see, *e.g.*, col. 3 lines 28-65, particularly lines 35-39). In both references, the receiver proceeds, after the measurement interval, to estimate the channel from each transmit antenna element (see, *e.g.*, item 3.b. of page 152 col. 1 of Gerlach, and col. 3 lines 53-55 of Harrison). As soon as the estimates are completed, they are provided as feedback to the transmitter (see, *e.g.*, the paragraph bridging cols. 3 and 4 in Harrison, and item 3.c. of page 152 col. 1 of Gerlach).

Gerlach teaches that measurement (probe) intervals should be alternated with information intervals (see, *e.g.*, last paragraph of page 151 col. 1 of Gerlach). Because feedback intervals extend from the end of one probe interval to the end of the next probe interval, which includes an

information interval, the feedback interval necessarily *exceeds* the measurement interval (that is, the measurement interval is only part of the feedback interval).

A similar result obtains in Harrison. In Fig. 8 of Harrison, for example, the measurement interval occupies only the block 502. Blocks 504 through 524 are necessary before feedback can be sent to the transmitter (block 526 or 528); and a new measurement interval will not be useful until the transmitter has received the feedback and changed the antenna weighting accordingly. As such, the interval between feedback (the feedback interval) is necessarily *longer* than the duration of the measurement itself (the measurement interval).

Thus, for both Gerlach and Harrison, it is clear that the measurement interval is *less* than the feedback interval, which is precisely opposite to the requirement of Claim 1. Certainly, neither Gerlach nor Harrison makes any suggestion that might lead one to establish measurement intervals that *exceed* the feedback periods, as required by Claim 1. A method suggested by the Applicant to effect this unexpected feature is to *overlay* perturbation weight vectors, as shown for example in Figure 12 and described from page 39 line 28 to page 40 line 15. The *measurement intervals*, during which the signals are measured and integrated, are as long as a particular perturbation is transmitted, thus provide relative insensitivity to noise. A different perturbation vector is overlaid when a first perturbation is only partly completed (when half completed, in the example of Figure 12). Feedback decisions, however, can be rendered every time a new perturbation is overlaid, permitting feedback intervals to be *shorter* than measurement intervals, thereby providing relatively higher feedback rates (and thus the feedback is fresher, on average).

Distinctions Between Cited References and Other Claims

The foregoing remarks provide overwhelming support for the conclusion that the cited references, whether taken individually or in combination, fail to teach, disclose or fairly suggest a multiplicity of features required by Claim 1. As such, Claim 1 is clearly nonobvious over any combination of the cited references.

The remaining independent Claims 24 and 29-30 are nonobvious over any combination of the cited references for similar reasons. Claim 24 has elements that are similar enough to elements of Claim 1 that the Examiner will readily see that the cited references fail to teach the required limitations for similar reasons as set forth with respect to Claim 1, above. Claims 29-30 also require weight vector perturbation vectors, as well as a measurement interval having a greater duration than a feedback interval. Claim 31 is amply distinguished from the cited art by the requirement that the measurement interval exceeds the feedback interval. Thus, because both of the cited references fail to teach, disclose or fairly suggest either weight vector perturbation vectors or a measurement interval having a greater duration than a feedback interval, each of the independent Claims 1, 24 and 29-31 are nonobvious over any combination of the cited references.

All remaining claims are accordingly nonobvious over the cited references at least by virtue of properly depending from a nonobvious independent claim.

Conclusion

The foregoing remarks support a conclusion that all of the claims of the subject application, as presently amended, are nonobvious over any combination of the cited references. As such, the Examiner is respectfully requested to withdraw the grounds for rejection set forth in the current Office Action and to reconsider the pending claims, as presently amended. I

The present amendments correct errors identified during review by the undersigned, but are generally non-narrowing, and are unnecessary to overcome the grounds for rejection set forth by the Examiner. As such, if the Examiner finds new grounds for rejection, it is respectfully submitted that a further non-final Office Action would be appropriate. If no further grounds for rejection are found, then the Examiner is respectfully requested to promptly issue a Notice of Allowance in respect of all pending claims.

The Commissioner is authorized to construe this paper as including a petition to extend the period for response by the number of months necessary to make this paper timely filed. Fees or deficiencies required to cause the response to be complete and timely filed may be charged, and any overpayments should be credited, to our Deposit Account No. **50-0490**.

Respectfully submitted,

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